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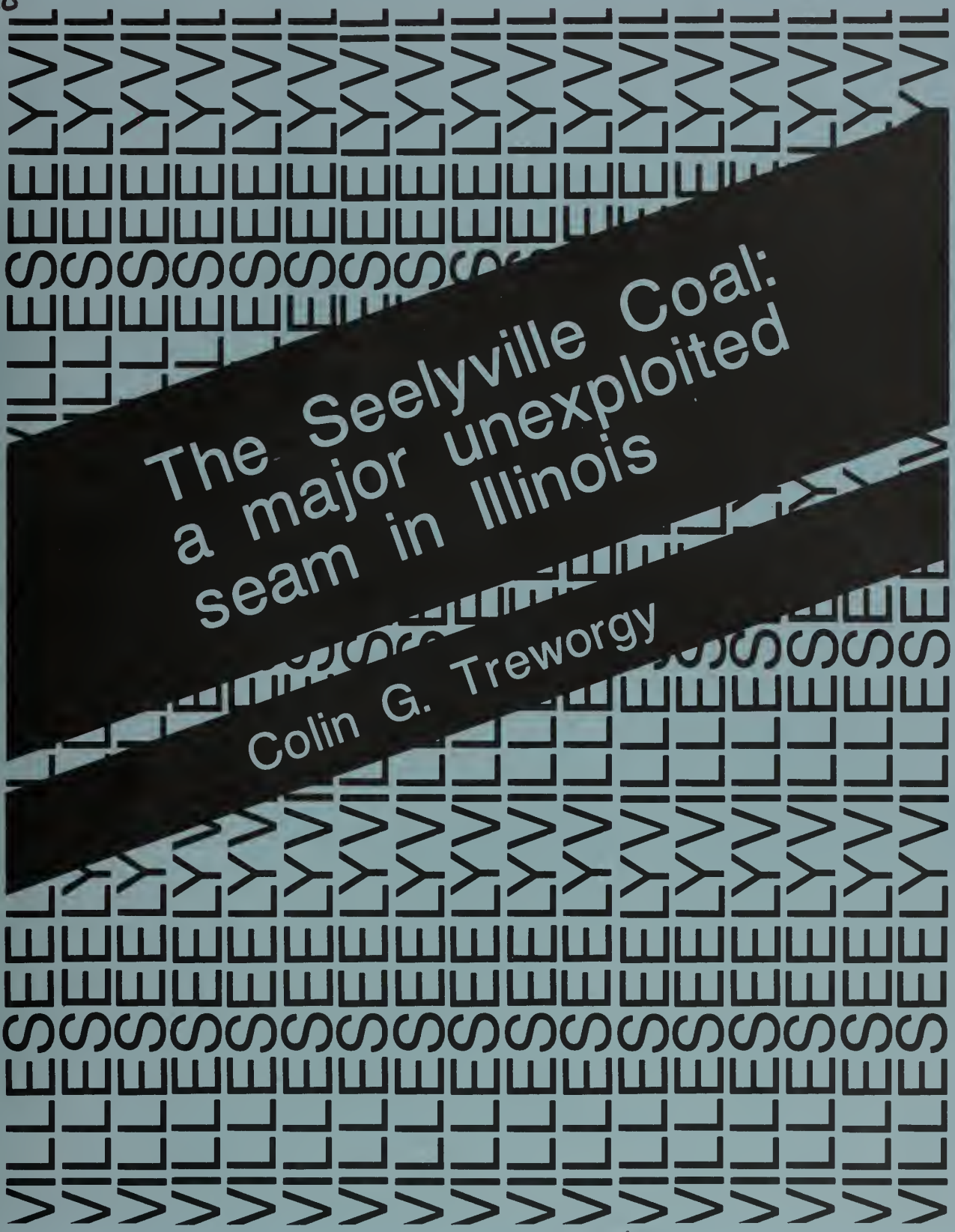

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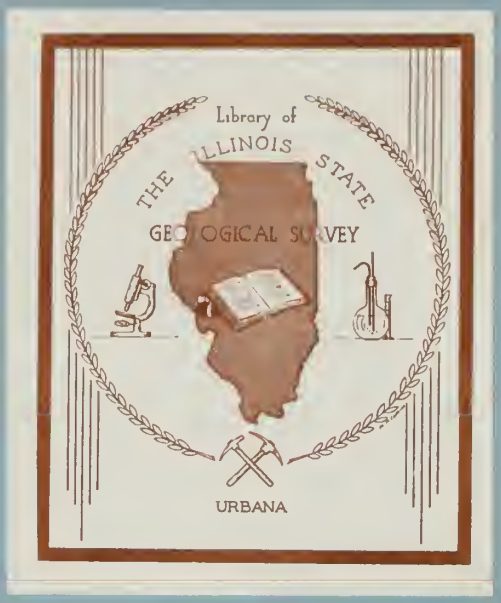

Treworgy, Colin G.
The Seelyville Coal : a major unexploited seam in Illinois. – Champaign, IL : State Geological Survey Division, March 1981.

11 p. ; 28 cm. – (Illinois mineral notes ; 80)

1. Coal–Illinois. I. Title. II. Series.

Printed by the authority of the State of Illinois/March 1981/2,000 copies.

ILLINOIS STATE GEOLOGICAL SURVEY
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The Seelyville Coal: a major unexploited seam in Illinois

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Colin G. Treworgy

ABSTRACT

New mapping at the Illinois State Geological Survey has revealed that a major minable coal seam, the Seelyville Coal Member of the Spoon Formation, underlies a large area of eastern Illinois. Although the Seelyville Coal has been actively mined in adjacent parts of Indiana for many years and its presence in Illinois known for some time, its extent in Illinois had not been determined. This study, which principally utilized geophysical logs from oil test holes, shows that the Seelyville Coal may be as much as 3½ to 9 feet thick under an area of approximately 1,900 square miles of Clark, Clay, Crawford, Cumberland, Edgar, Effingham, Jasper, Lawrence, Richland, and Shelby Counties. Possible in-place coal resources are estimated to be 8 billion tons. The Seelyville Coal has seldom been tested by coal companies in the study area.

The Seelyville Coal lies about 160 to 240 feet below the Springfield (No. 5) Coal Member of the Carbondale Formation and ranges from 350 to 1,500 feet deep in the area studied. The Seelyville usually has one or more shale partings that vary in thickness from a few inches to several feet. Since it is difficult to determine the number and thickness of the partings from available geophysical logs, estimates of coal resources are therefore somewhat uncertain. Often the coal has a siltstone or sandstone roof; in some areas cutouts in the coal are numerous. Core data are needed to confirm coal thickness and to evaluate the water content and strength of the sandstone and the quality of the coal. The Seelyville Coal has significant resource potential and warrants further exploration.

ILLINOIS STATE GEOLOGICAL SURVEY
Natural Resources Building
615 East Peabody Drive
Champaign, IL 61820
March 1981

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Cover design and drafting: Craig Ronto

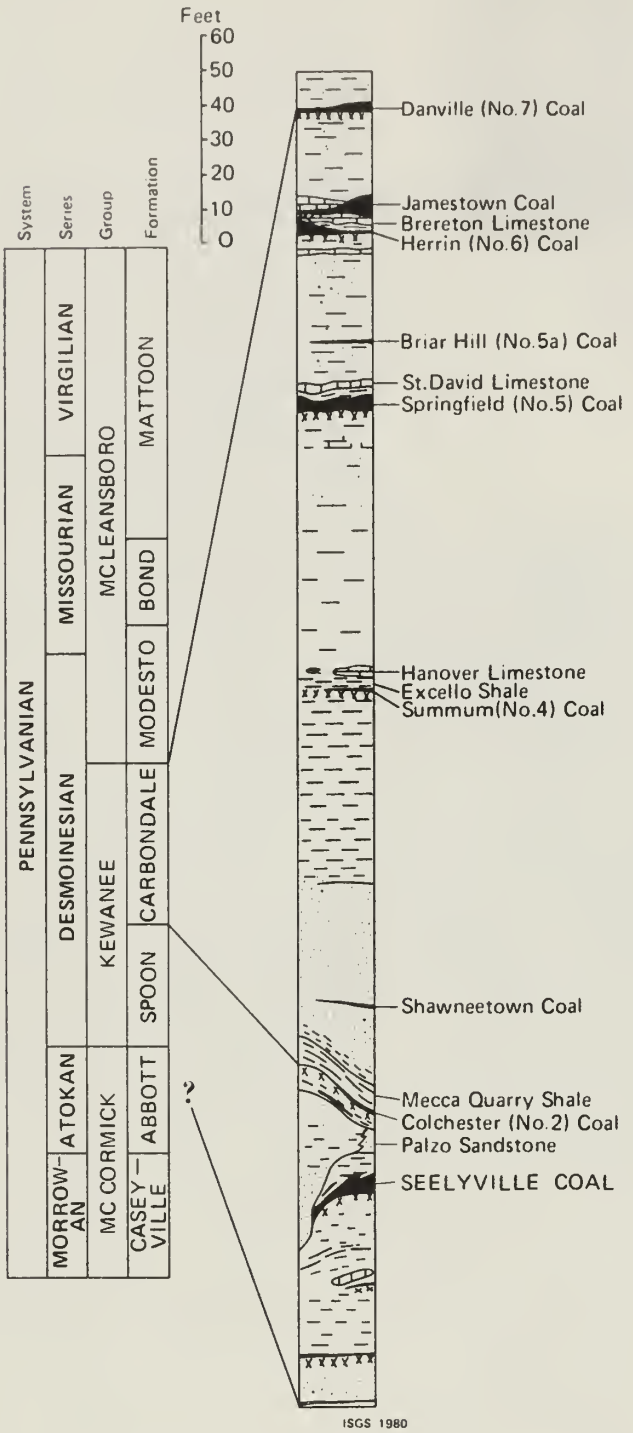

Figure 1. Stratigraphic position of the Seelyville Coal and associated strata.

INTRODUCTION

As the demand for coal increases and the shallow, easily explored deposits are depleted or commited to markets, mining companies will have to direct their exploration efforts to deeper coals. Illinois has two thick coal seams which underlie large areas of the state at relatively shallow depths. These two seams, the Herrin (No. 6) and Springfield (No. 5) Coal (also called Harrisburg Coal), constitute 74 percent of the state's identified coal resources and account for almost all of the current annual production. Historically, coal test holes in Illinois have seldom been drilled below the No. 5 Coal; consequently, relatively little is known about deeper coals in the state.

In this study geophysical logs from oil-test holes were used to investigate coals below the No. 5 Coal in eastern and central Illinois. The Seelyville Coal, a member of the Spoon Formation (fig. 1), is found 4 to 70 feet below the Colchester Coal (the base of the Carbondale Formation) and 160 to 240 feet below the No. 5 Coal. The Seelyville has not been recognized in outcrop anywhere in Illinois and is known only from drilling information. The areal extent of the coal remained unknown until this study because of the scarcity of coal test holes in the central and eastern portions of Illinois. For this reason, the Seelyville Coal has remained relatively unknown and unexploited in Illinois, although it has been extensively mined in adjacent areas of Indiana. This report summarizes current knowledge of the Seelyville Coal in Illinois and discusses the coal's potential for mining.

PREVIOUS INVESTIGATIONS

The Seelyville Coal was first described in Indiana by Ashley (1899), and in 1909 (p. 57) he named it the Indiana Coal III. The coal is described in several publications of the Indiana Geological Survey. Cady (1952) reported the presence of the Indiana III in eastern Illinois. He identified the coal in drill holes in five counties and mapped a total of 1.8 billion tons of resources. Kosanke et al. (1960) formally named the seam in Illinois the Seelyville Coal Member. Clegg (1965) used geophysical logs to trace the coal throughout Clark and Edgar Counties. He stated that the coal has an "apparently limited areal extent in Illinois" and "thins and ultimately pinches out a few miles west of the Indiana-Illinois boundary." Clegg also mentioned the occurrence of sandstone cutouts in the coal in some localities.

MAPPING WITH GEOPHYSICAL LOGS

In recent years geologists have utilized geophysical logs of oil test holes to map thickness of coal (Hopkins, 1968;

Allgaier and Hopkins, 1975; Tixer and Alger, no date). Although the reliability of information obtained from these logs is generally not comparable to coal-test drillers' logs or diamond drill cores, the geophysical logs are useful for preliminary mapping of unexplored areas.

Thousands of oil test holes penetrate the coal bearing strata in east-central Illinois. More than 1,500 geophysical logs from these holes were examined in mapping the Seelyville Coal for this study. Figures 2 through 5 show the characteristic appearance of the Seelyville on various types of logs and demonstrate some of the problems encountered in using geophysical logs.

Most of the logs used in this study were spontaneous potential/resistivity logs from oil test holes. The Seelyville Coal is generally identified on resistivity logs by a prominent deflection 4 to 70 feet below the Colchester Coal horizon, a prominent inflection traceable throughout most of the Illinois Basin (fig. 2). The low resolution and small scale (1 in. = 50 ft) of the logs cause difficulty in measuring thickness of the coal.

The gamma ray/neutron log (fig. 3) confirms that the deflection identified on the resistivity log as the Seelyville Coal is, in fact, coal. Though few in number, gamma ray/density, neutron, or sonic logs are distributed throughout the study area and verify the presence and thickness of the coal; because these logs have a higher resolution and

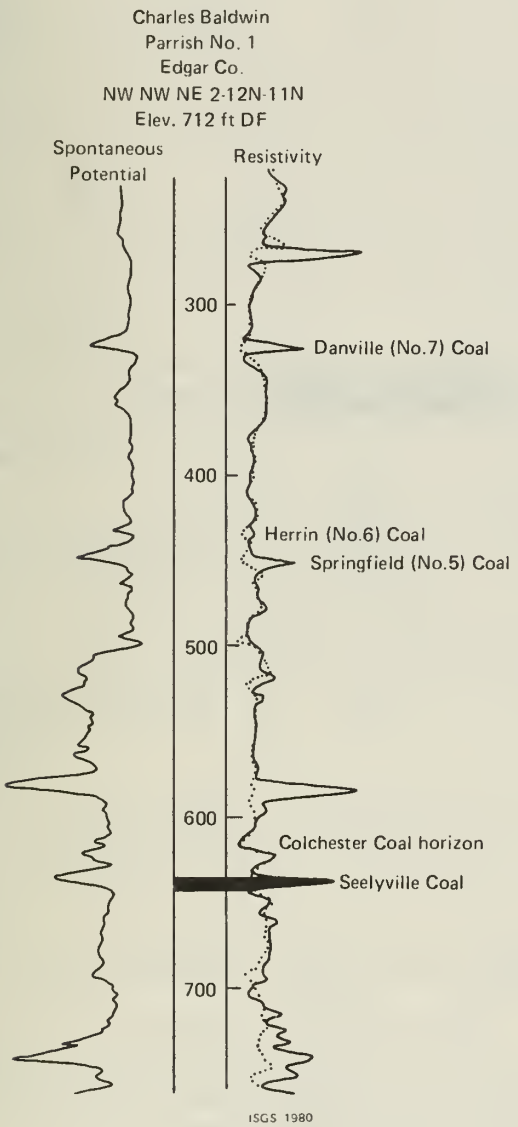

Figure 2. Typical spontaneous potential/resistivity log of the Seelyville Coal and associated strata.

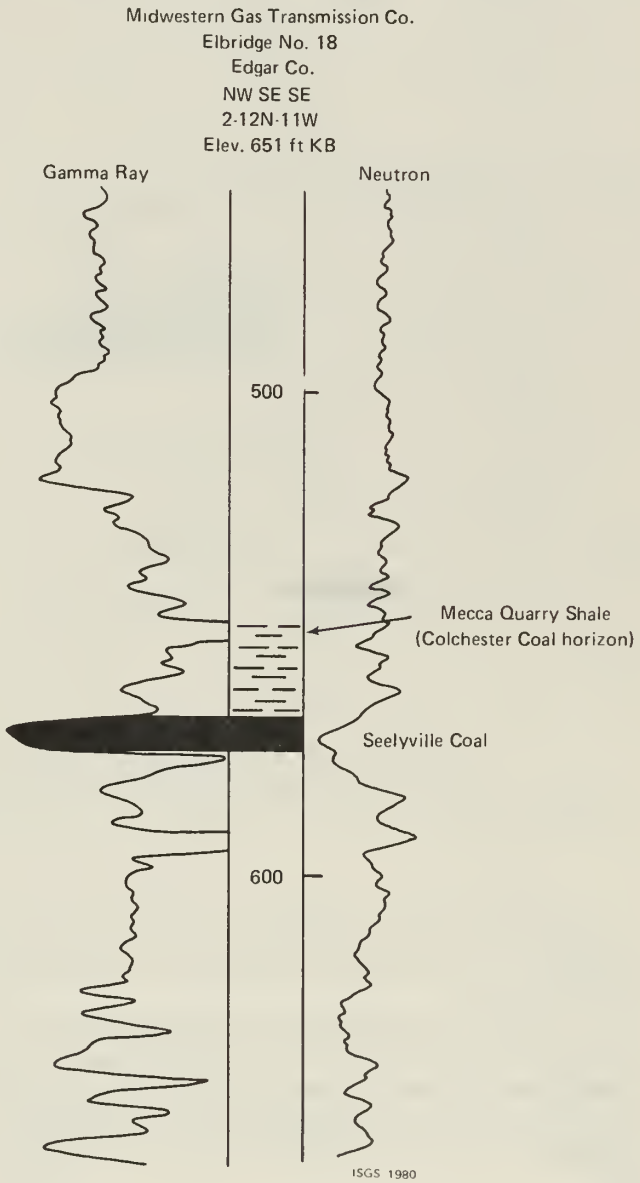

Figure 3. Typical gamma ray/neutron log of the Seelyville Coal and associated strata.

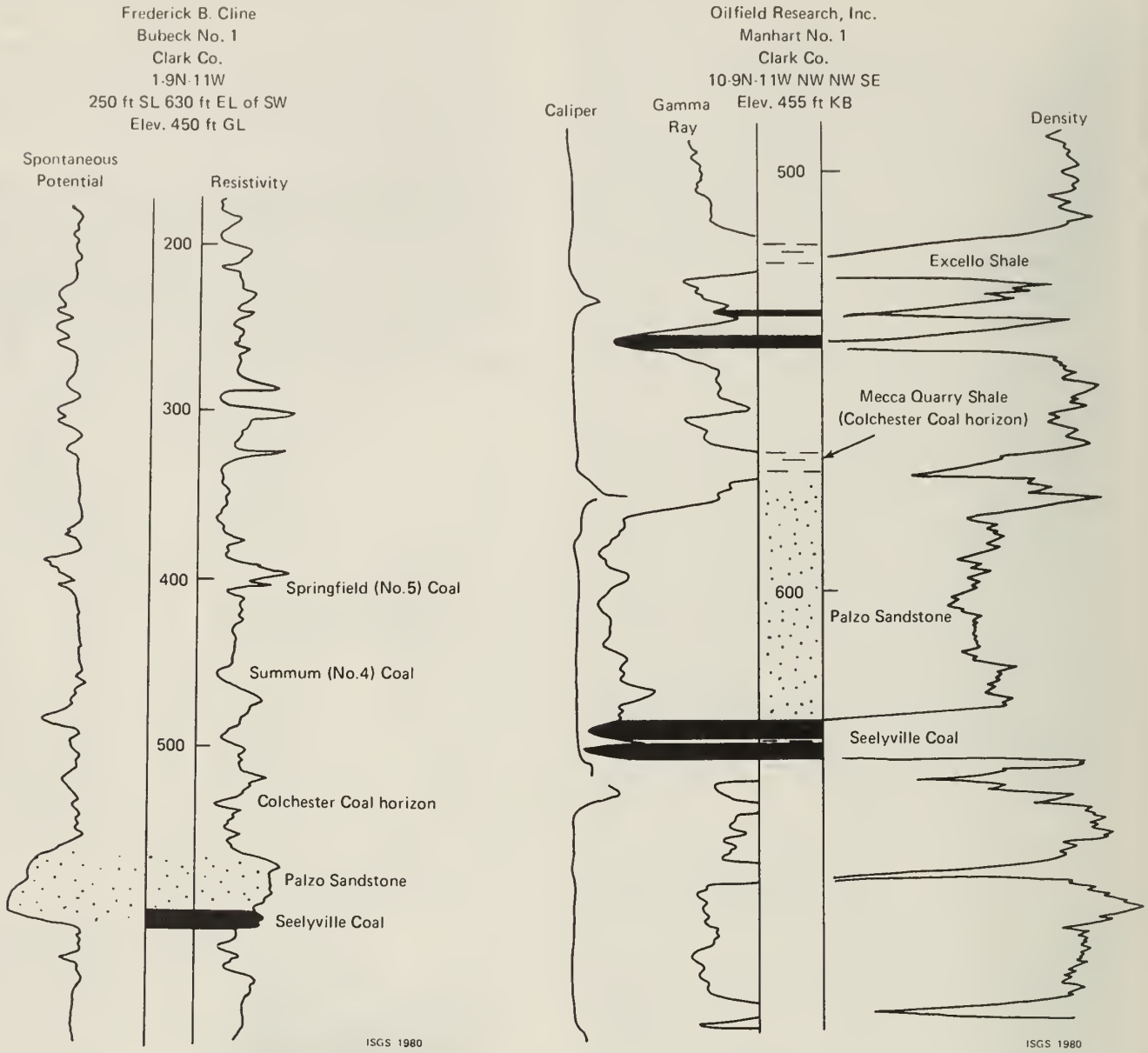

Figure 4. Sandstone overlying the Seelyville Coal; spontaneous potential/resistivity log (left) and gamma ray/density log (right).

larger scale than do the resistivity logs, they allow somewhat more accurate estimates of thicknesses of coal and shale partings.

In some areas a thick sandstone (the Palzo Sandstone Member) rests directly on the Seelyville Coal (fig. 1). On some resistivity logs in these areas the coal-sandstone boundary is difficult to identify (fig. 4). In this situation the geologist may underestimate the thickness of the coal or not recognize its presence. The coal-sandstone and coal-shale contacts are readily identifiable on gamma ray logs (fig. 4).

The Seelyville Coal commonly has one or more shale partings. If present, the partings are usually located in the middle or upper part of the seam and range from a few inches to several feet thick. Figure 5 shows two benches of Seelyville Coal separated by about 8 feet of shale.

EXTENT AND THICKNESS OF THE SEELYVILLE COAL

The trends in thickness of the Seelyville Coal are shown in figure 6. Although this figure can serve as a guide for further exploration, core data are needed to confirm coal thickness and to estimate resources with greater certainty. Approximately 1,900 square miles of east-central Illinois are underlain by the Seelyville Coal, which is 3½ feet or more thick. The Seelyville Coal is estimated to be more than 5½ feet thick in several large areas and as much as 9 feet thick in a few locations. The coal thins and is difficult to trace over the La Salle Anticlinal Belt in Douglas, Coles, and Edgar County and is eroded along the northern part of the anticlinal belt in Douglas County. The Seelyville becomes thin and difficult to trace to the north and west of the mapped area. The coal is reported to be of minable thickness in parts of Vermilion County (Cady, 1952). To the south, the Seelyville thins and splits into two benches. The Seelyville is presently correlated as slightly younger than the De Koven Coal of southern Illinois (Kosanke et al., 1960); however, it is possible that one or both benches of the Seelyville are correlative with the De Koven and/or Davis Coals of southern Illinois. The De Koven and Davis Coals are found at about the same stratigraphic position as the Seelyville.

Where distinguishable, the thickness of the Seelyville Coal was mapped exclusive of shale partings. In areas where the parting was recognized to be 2 feet or greater in thickness, only the thicker coal bench (generally the lower bench) was mapped. This limit was chosen because partings thinner than 2 feet cannot be accurately measured on most geophysical logs. In practice, it may be uneconomical to mine shale partings thinner than that.

Resources of in-place coal greater than 3½ feet thick are estimated to be 8 billion tons (table 1). This estimate does not include 1.7 billion tons of coal mapped within areas densely drilled for oil.

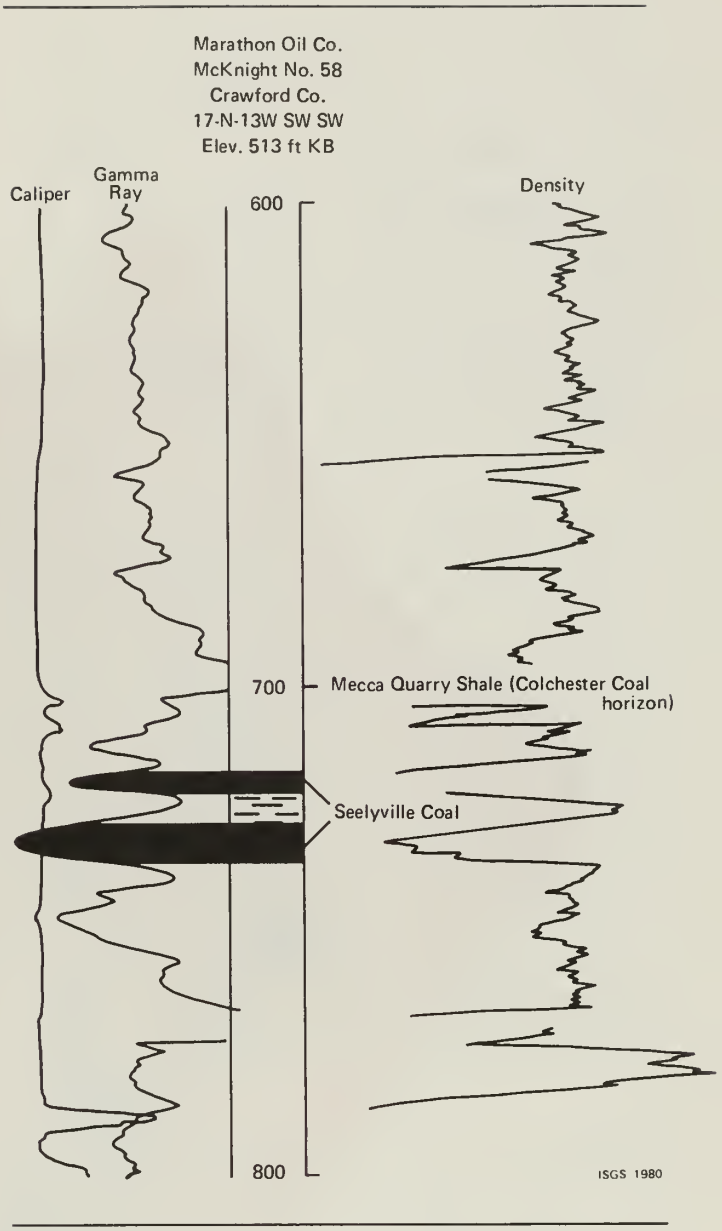

Figure 5. Thick shale parting in the Seelyville Coal.

Table 1. Resources of Seelyville Coal (thousands of tons)

County	3½ to 5½ ft	5½ to 7½ ft	>7½ ft	Total
Clark	749,016	285,228	–	1,034,244
Clay	30,816	–	–	30,816
Coles	14,328	–	–	14,328
Crawford	777,888	698,760	–	1,476,648
Cumberland	1,164,312	120,960	–	1,285,272
Edgar	583,560	305,100	–	888,660
Effingham	281,016	96,120	–	377,136
Jasper	1,316,448	637,200	69,120	2,022,768
Lawrence	487,728	38,556	–	526,284
Richland	59,544	76,140	–	135,684
Shelby	203,688	2,268	–	205,956
Total	5,668,344	2,260,332	69,120	7,997,796

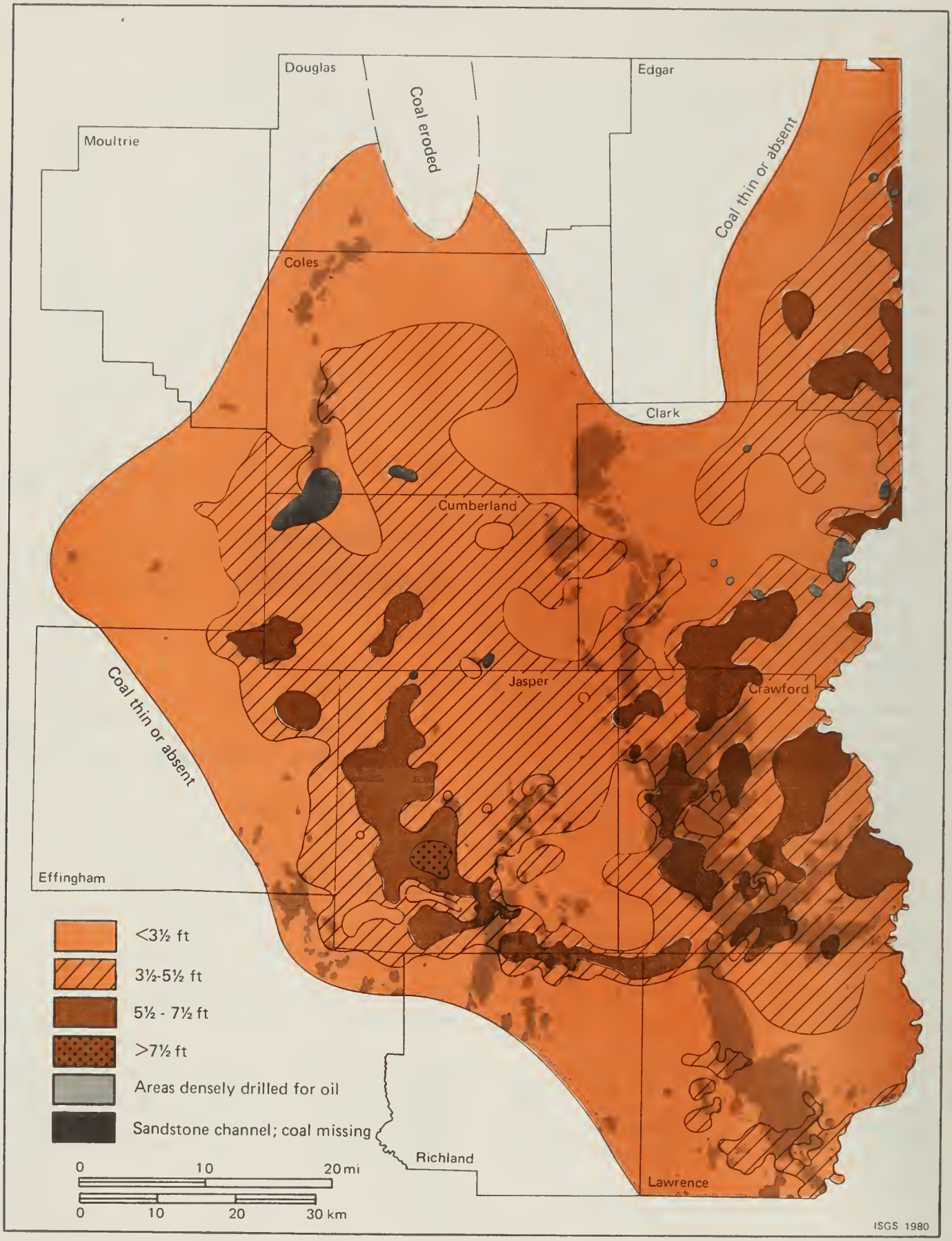

Figure 6. Thickness (ft) of the Seelyville Coal.

DEPTH AND STRUCTURE OF THE SEELYVILLE COAL

The depth to the Seelyville Coal ranges from less than 350 feet in eastern Edgar County to more than 1500 feet in Jasper County (fig. 7). Because of the relatively level topography of the study area, the depth map presents essentially the same picture as a structure map. The Seelyville Coal dips gently westward from its outcrop in western Indiana into the Marshall Syncline. The coal rises slightly along the west flank of the syncline onto the La Salle Anticlinal Belt and then plunges relatively steeply down the west flank of the anticlinal belt into the broad Fairfield Basin. The greatest regional change in slope, less than 250 feet per mile, occurs along the west flank of the La Salle Anticlinal Belt.

The depth of much of the Seelyville Coal may delay its minability from both a technical and marketing standpoint. The size of pillar needed to support the mine roof increases with depth. The larger the pillar the lower the percentage of coal extracted. Although there has been little experience with mining coal deeper than 700 feet in Illinois, Weir and McNulty (1979) have suggested that room and pillar mining may be marginally economical at depths of 700 to 1,000 feet and uneconomical at depths greater than 1,000 feet. Longwall mining may be the most economical way to recover the Seelyville Coal where it is deeper than 1,000 feet.

MINING CONDITIONS

Little is known about the geologic conditions that may be encountered mining the Seelyville Coal. The only production from this coal in Illinois has been from Snow Hill Coal Company's Green Valley Mine. Located near West Terre Haute, this mine operated mostly in Indiana, but extended a short distance into Illinois before being abandoned in 1963 (Clegg, 1965). This mine experienced localized water and roof problems (Clegg, 1965; Illinois State Geological Survey mine notes).

Using geophysical logs and the few available core descriptions, three types of roof have been identified for the Seelyville Coal. The lithology making up the roof is related to the thickness of the interval between the Colchester and the Seelyville Coals. Although some general statements can be made about the possible behavior of various lithologies, core drilling is required for a full assessment of the strength of the roof.

1. *The first roof type is found where the Seelyville Coal lies 4 to 10 feet below the Colchester Coal ("1" on fig. 8).* In this situation, the interval between the coals consists of claystone, shale, and siltstone. In some areas thin rider coals or sandstone may also be present. The claystone and rider coals, as well as the Colchester Coal, almost certainly can cause unstable roof conditions. The strata immediately above the Colchester Coal consist of black and gray shales. There are no known limestones present to provide a secure anchor for roof bolts. Although not widespread, this roof type has been found in parts of eastern Edgar County and northern Cumberland County.

2. *The second roof type is found where the Seelyville Coal is 10 to 30 feet below the Colchester Coal (fig. 8).* In these areas the interval between the coals consists largely of siltstone and shale with some sandstone. This is the most common roof type observed for the Seelyville Coal. In some areas the upper bench of the Seelyville extends up into this interval and may be separated from the main bench by more than 8 feet of shale. This upper bench of coal may contribute to roof instability.

3. *The third roof type occurs where the Seelyville Coal lies 30 to 70 feet below the Colchester Coal.* The interval consists predominantly of massive sandstone (Palzo Member), sometimes interbedded with siltstone (fig. 8). The sandstone either directly overlies the coal or is separated from it by a few feet of siltstone. The sandstone generally grades upward into shale and apparently grades laterally into the siltstone described in roof type 2. It could not be determined whether the coal was partially eroded in areas where it was directly overlain by sandstone. However, Wiram (1976) observed this sandstone, or its equivalent, at a strip mine in Indiana and found that the top of the coal had been eroded in places where it was directly overlain by sandstone. He also noted that the sandstone filled cutouts of some shale and sandstone units which overlie the coal, but was in facies relationship with other shales overlying the coal. Massive sandstone often makes a strong roof; however, it may also cause water problems.

The transition from roof type 2 to roof type 3 takes place abruptly over a short distance (about 1 mile). Areas of roof type 3 are found throughout the study area.

In some areas the Seelyville Coal is missing and massive sandstone occupies the coal horizon. This situation was found in many, but not all, of the areas where the coal is overlain by massive sandstone. The sandstone probably represents ancient drainageways which were active during or after the time of the Seelyville Coal swamp; however, because of insufficient data it has been impossible to map any drainage pattern, and little is known about the dimensions or geometry (sinuosity) of these channels.

In one area adjacent to a sandstone occupying the position of the coal the Seelyville splits into two benches and the split thickens toward the sandstone. This suggests that the sandstone may have been deposited contemporaneously with the peat.

On some logs there appears to be a thin coal above the massive sandstone but below the Colchester Coal; there are indications that this coal is an upper split of the Seelyville Coal. If this is the case, then the deposition of

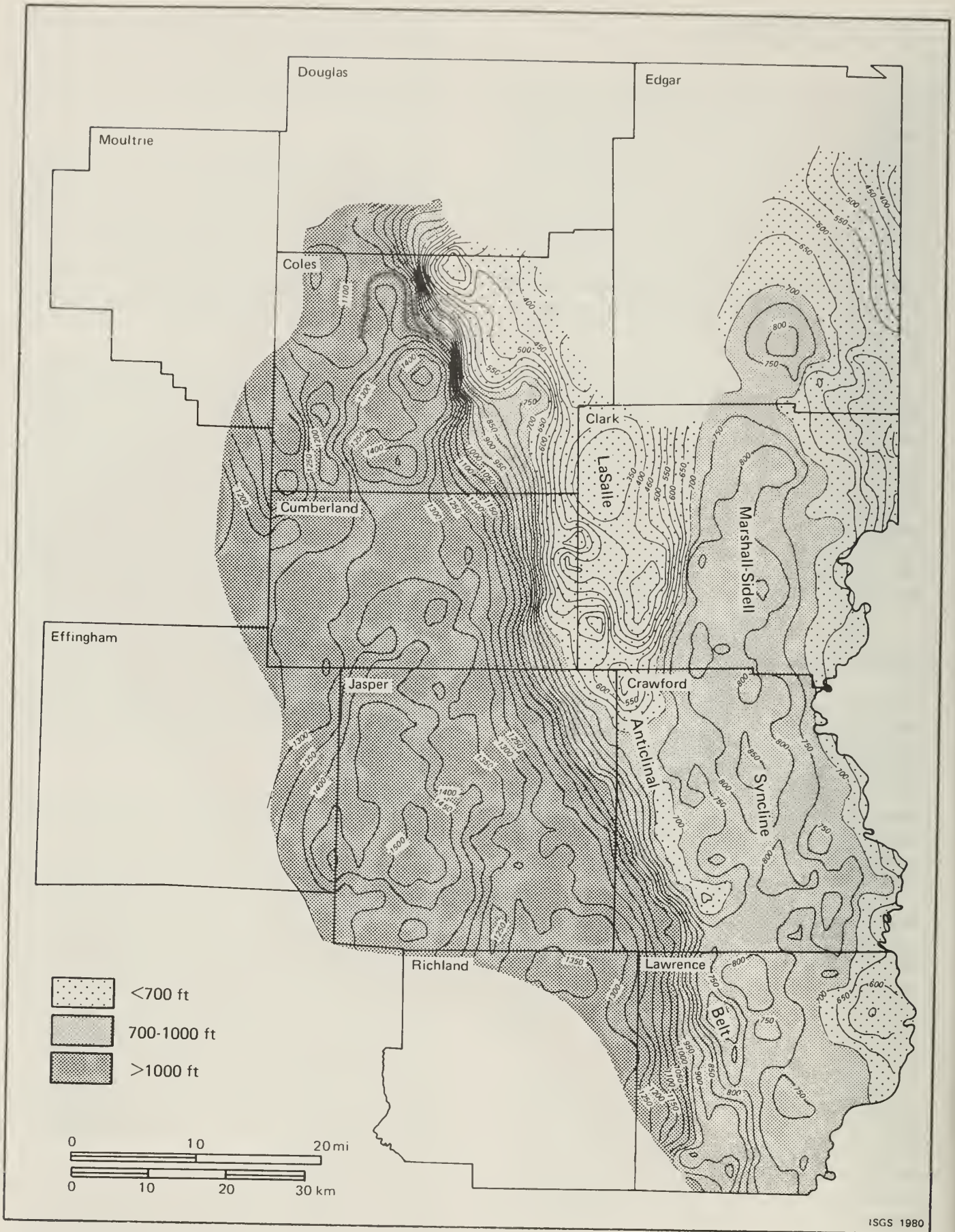

Figure 7. Depth (ft) of the Seelyville Coal.

the sandstone was contemporaneous with at least part of the peat accumulation.

QUALITY OF THE SEELYVILLE COAL

Little is known about the quality of the Seelyville Coal in Illinois. The most complete analysis available is from the coal sampled within a few miles of Illinois in the Green Valley Mine (table 2; I in fig. 9). The coal in this mine had a relatively low moisture content (10.2 percent as received, 11.3 percent ash-free basis), about 2 percent below what would be expected from the regional coalification pattern (Damberger, 1971); consequently, the heating value is on the high side (11,604 Btu/lb as received).

Sulfur content

The sulfur content is within the range of a normal high sulfur coal in Illinois. The only other analysis available is from a drill core drilled in Section 26, T. 13 N., R. 11 W., Edgar County (table 2; II in fig. 9). The sulfur content was very high (7 percent as received), probably because the sample analyzed included a 2-inch "sulfur vein" (probably a pyrite nodule) 2 feet from the top of the coal core and a 1/8-inch "sulfur vein" near the bottom. Partings were exluded from the samples from the Green Valley Mine, but were not excluded from the core.

Analyses were made of drill cuttings of the Seelyville Coal from two oil wells in Lawrence and Jasper Counties (III and IV in fig. 9). Drill cutting samples are not accurate representations of the coal because during the time it takes for cuttings to be washed to the surface (several minutes), portions of the sample may be lost and impurities added from other stratigraphic horizons. However, the samples can be used to determine the relative sulfur

Table 2. Analysis of the Seelyville Coal

I		II	
Snow Hill Coal Co. Green Valley Mine Composite of 3 face channel samples Analysis by ISGS Aug. 1963 All partings > 3/8 in. removed		Peabody Coal Co. Morton No. 1 SW SW 26, 13N-11W Edgar Co. Analysis from core Fall 1912 by Krehbiel Co., Chicago Partings not removed	
	As received		As received
Moisture	10.2	Moisture	9.0
Volatile matter	39.3	Volatile matter	34.91
Fixed carbon	40.8	Fixed carbon	42.87
Ash	9.7	Ash	13.22
Hydrogen	6.20	Total sulfur	7.01
Carbon	63.97	Btu per lb	11,227
Nitrogen	1.04		
Oxygen	15.44		
Total sulfur	3.61		
Sulfate sulfur	.01		
Pyritic sulfur	2.16		
Organic sulfur	1.44		
Total chlorine	.37		
Water soluble chlorine	.21		
Btu per lb	11,604		
Maximum fluidity (div/min)	22,700		
Free swelling index	4		

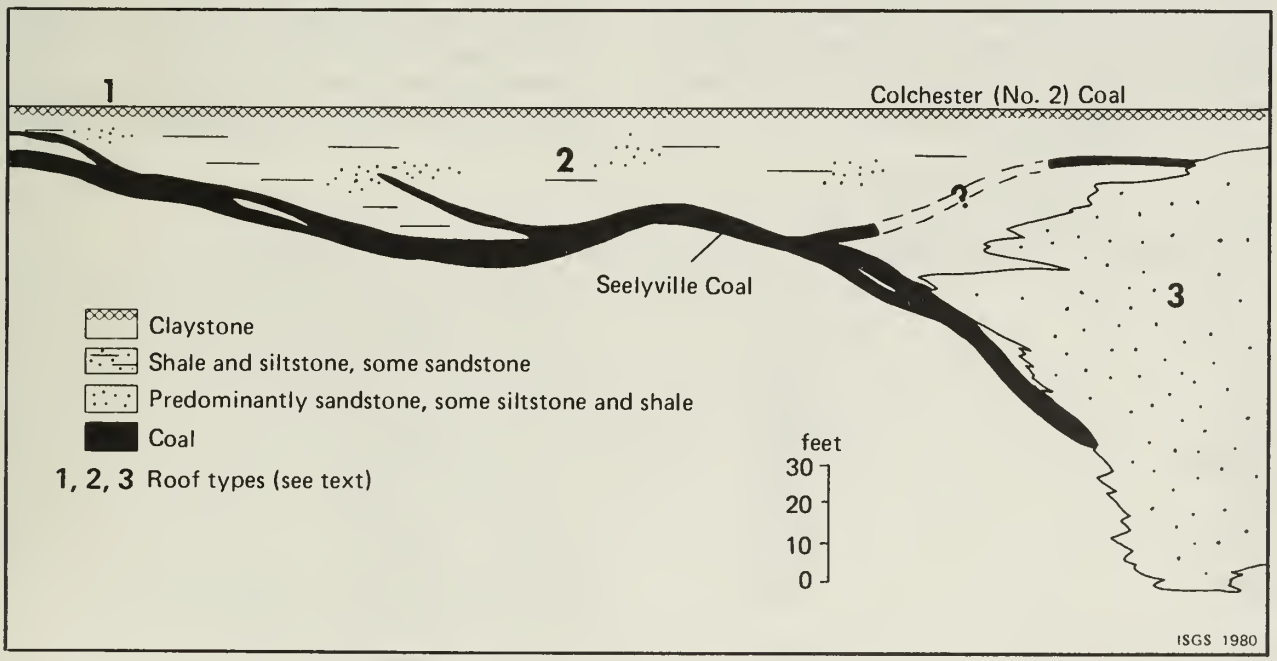

Figure 8. Variation of the roof rock of the Seelyville Coal (schematic).

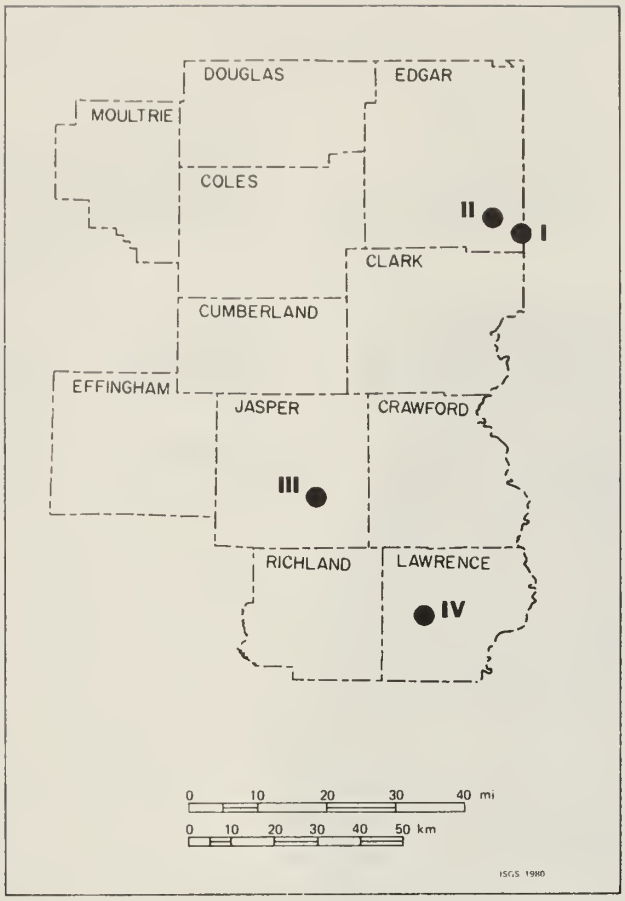

Figure 9. Location of analyses of the Seelyville Coal.

content of the coal. The actual sulfur content of the coal would be expected to be higher than that of the cuttings. The Jasper County sample (III in fig. 9) had an "as received" sulfur content of 2.5 percent and the Lawrence County sample (IV in fig. 9), 3.6 percent. These analyses indicate that the sulfur content of the coal in these areas is rather typical for high sulfur coal of Illinois.

Chlorine content

The chlorine content of coal has been linked to the occurrence of corrosion and fouling of high temperature boilers. Chlorine content generally increases with coal depth, but there is not a direct correlation between depth and chlorine content. Figure 10 shows the areal distribution of chlorine in the Herrin (No. 6) Coal. The Seelyville Coal, which lies as much as 350 feet below the Herrin Coal, is expected to have a slightly higher chlorine content. Coals with chlorine contents of 0.5 percent or greater may require special preparation or utilization. However, no coal in Illinois is currently considered unusable because of chlorine content (Gluskoter and Rees, 1964).

AREAS DENSELY DRILLED FOR OIL

Oil and gas wells that have been drilled throughout east-central Illinois present problems for underground mining of the Seelyville Coal in some areas. By law, a pillar of unmined coal must be left around each well. The dimensions of the pillar may vary with mining plans, but, in general, about 2 acres of coal per well are left unmined. Mine layouts must be carefully planned in areas of numerous, closely spaced wells. Mine development cannot be carried out where wells are spaced one for each 20 acres or less over large areas. Rooms cannot be developed in areas where wells are spaced evenly 10 acres or less.

Areas where the density of wells will inhibit mining are shown on figure 6; 1.7 billion tons of mapped coal were within densely drilled areas (table 3). This coal was excluded from the estimate of resources listed in table 1. The economic feasibility of plugging wells for mining depends on the amount of coal which will become available. In some cases, plugging one or two wells may clear the way for mining a large area of coal; however, in other cases, plugging many wells will clear only a relatively small acreage of coal.

Table 3. Tonnage of Seelyville Coal excluded from resources because of dense drilling for oil and gas. (thousands of tons)

County	3½ to 5½ ft	5½ to 7½ ft	Total
Clark	42,912	864	43,776
Clay	5,760	–	5,760
Coles	722,160	–	722,160
Crawford	394,200	340,200	734,400
Cumberland	33,336	972	34,308
Edgar	504	3,348	3,852
Effingham	6,840	–	6,840
Jasper	94,752	33,372	128,124
Lawrence	31,032	3,348	34,380
Richland	5,328	3,240	8,568
Shelby	–	–	–
Total	1,336,824	385,344	1,722,168

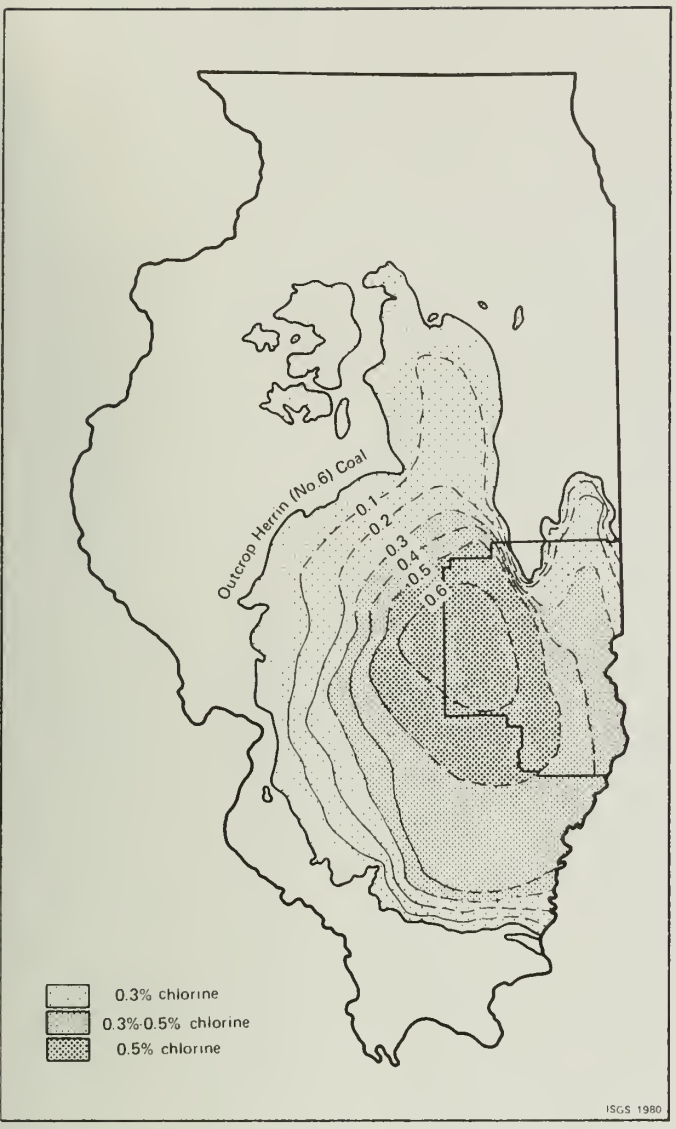

Figure 10. Chlorine content of the Herrin (No. 6) Coal. (From Gluskoter and Rees, 1964)

SUMMARY

The large areal extent of Seelyville Coal, which is greater than 3½ feet thick, make the Seelyville one of the major seams in Illinois. Although the extreme depth of the seam and the desnisty of oil well drilling may delay or limit the development of the coal in some regions, significant areas may be favorable for mining in the near future.

Much remains to be learned about the Seelyville Coal before its full potential is known. This report is intended as a guide for further investigations. Carefully planned exploration programs are needed to confirm the thickness of the coal, determine the nature and distribution of the coal partings, and evaluate the quality of the coal and the roof strata.

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